

REMARKS

Claims 1-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wong et al. (6,436,760) in view of Shen (6,472,702). Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wong et al. in view of Shen and Gonzalez (5,198,386). Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wong et al. in view of Shen, Gonzalez, and Wu et al. (6,391,706). Response to the Office action identified in the above is listed below.

1. Objection to the drawings:

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: 37; see figure 4. A proposed drawing correction, corrected drawings, or amendment to the specification to add the reference sign(s) in the description, are required.

Response:

To overcome this, numeral 37 is deleted in Figs. 4-5. No new matter is introduced. Allowance of the drawing corrections is politely requested.

2. Rejection of claims 1-5 under 35 U.S.C. 103(a):

Claims 1-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wong et al. in view of Shen. For reasons of record that can be found on pages 2-4 in the Office action identified above, which is part of paper no 01282004.

Response:

According to claim 1 of the present application, the main characteristics of the method for fabricating a trench capacitor include forming a mask layer for partially masking the collar oxide layer, and removing a portion of the collar oxide layer not masked by the mask layer and Poly2; meanwhile, the collar oxide layer masked by the mask layer is preserved to form a single-sided spacer on the sidewall of the recess. After that, Poly3 is formed on Poly2 near the single-sided spacer. Accordingly, when dopants of the heavily doped Poly2 diffuse out through Poly3 to the surrounding substrate, they do not diffuse into the surrounding substrate masked by the single-sided spacer and therefore form a non-annular buried strap out diffusion. Accordingly, no leakage of signal charge will happen between two adjacent trench capacitors when the active area (AA) is misaligned.

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The Examiner stated that Wong et al. disclose forming a collar oxide layer (8) on sidewall of the first recess; performing a second polysilicon deposition and recess etching to embed a Poly2 layer (11) on the Poly1 layer (7); forming a mask layer partially masking the collar oxide layer (8); removing the collar oxide layer (8) not masked by the mask layer (8) and the Poly2 layer (11); removing the mask layer (Fig. 13-14; col. 6, lines 41-55); and performing a third polysilicon deposition and recess etching to embed a Poly3 layer (14) on the Poly2 layer (11).

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In view of the specification and claims of Wong et al., they disclose a method for removing surface oxide from polysilicon by depositing a very thin layer of germanium over the polysilicon immediately before a subsequent polysilicon deposition step and heating the germanium-coated polysilicon in a vacuum to sublime volatile germanium oxide. In the specification, Wong et al. use the formation of a trench capacitor as an embodiment to teach how to remove oxide residue on Poly1 or Poly2 through their method. However, Wong et al. do not mention or teach the steps of "forming a mask layer partially masking the collar oxide layer (8); and removing the collar oxide layer (8) not masked by the mask layer (8) and the Poly2 layer (11)" in the abstract, specification, or drawings.

In Figs. 13 and 14, Wong et al. teach the conventional steps of forming an oxide layer 8 on the sidewall of the trench on the Poly1 and removing portions of the oxide layer 8 covering the Poly1 (column 6, lines 41-55). Therefore, Figs. 13 and 14 only shows the formation of the circular collar oxide layer on the sidewall of the trench before forming Poly2, and that is different from the stage of removing the collar oxide layer on the sidewall of the trench and Poly2. Consequently, Figs. 13 and 14 do not teach the step of removing only a portion of the collar oxide layer on the sidewall of the trench to form a single-sided spacer, which is one of the characteristics according to claim 1 of the present application.

Instead, Figs. 19 and 20 show the stage of removing the oxide layer 8 positioned above Poly2. The description of Figs. 19 to 20 is as below: "A seventeenth step, shown in FIG. 19, includes partially etching the second arsenic-doped polysilicon layer 11 back to form a recess A in the trench. This etch back is performed to remove the collar oxide from the trench wall in a subsequent step. An eighteenth step, shown in FIG. 20, includes giving the substrate a short HF/Water rinse to remove oxide residue on the top of recessed polysilicon 11. (column 7, lines 18-26)"

Accordingly, there is no description about forming a mask layer and only removing a portion of the collar oxide layer above the Poly2. Therefore, Wong et al. never teach etching the collar oxide layer through a mask layer with a specific pattern to make a specific portion of the collar oxide layer stay on the sidewall of the trench, and taking the remaining collar oxide layer as a single-sided spacer so as to prevent the dopants of Poly2 from diffusing annularly and therefore to avoid leakage of signal charge. Consequently, the Applicants believe the assertion of the Examiner that Wong et al. discloses the process of forming a mask layer to partially remove the collar oxide layer is not true.

Regarding the patent of Shen, Shen never teaches forming a single-sided spacer above Poly2 to mask the substrate for preventing the dopants of Poly2 from forming an annular buried strap out diffusion.

In view of Gonzalez and Wu et al, they are also silent about forming a non-annular buried strap out diffusion by way of only removing a portion of the collar oxide layer.

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From the above discussion, the Applicants believe that it is non-obvious for a person of ordinary skill in the art at the time the invention was made to take the teachings of Wong et al. and Shen to accomplish the present application. Reconsideration of the objection over claims 1 is hereby requested.

As claims 2-5 are dependent upon claim 1, they should be allowed if claim 1 is allowed. Reconsideration of claims 2-5 is therefore requested.

3. Rejection of claims 6-7 under 35 U.S.C. 103(a):
Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wong et al. in view of Shen as applied to claims 1-5 above, and further in view of Gonzalez.

Response:

As claim 6 is dependent upon claim 1, claim 6 should be allowed if claim 1 is allowed. As claim 7 is dependent upon claim 6, it should be allowed if claim 6 is allowed. Reconsideration of the objection over claims 6-7 is hereby requested.

4. Rejection of claim 8 under 35 U.S.C. 103(a):
Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wong et al. in view of Shen and

Gonzalez as applied to claims 6 and 7 above, and further in view of Wu et al.

Response:

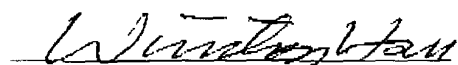
5 As claim 8 is dependent upon claim 7, claim 8 should be allowed if claim 7 is allowed. Reconsideration of claim 8 is therefore requested.

5. Addition of new claim 9:

10 From the above discussion, none of the prior art patents disclose the step of removing the collar oxide layer to leave a portion of the collar oxide layer on the sidewall of the trench to form a single-sided spacer. For further defining the characteristics
15 mentioned above of the present application, a new claim is added as described in the above AMENDMENT TO THE CLAIMS section. However, no new matter is introduced. Consideration of the new claim 9 is thereby politely requested.

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Sincerely yours,



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30 communication and I will return your call promptly.)